

## SUMMARY OF HARBOR SEAL DIET DATA COLLECTED IN ALASKA FROM 1990 – 1999

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### INTRODUCTION

During the past 20 years, harbor seal (*Phoca vitulina richardsi*) numbers have declined in several regions of Alaska including the western Gulf of Alaska (Pitcher 1990), Prince William Sound (PWS) (Frost *et al.* 1999), Aialik Bay (Hoover 1983, Hoover-Miller 1994), and northern Bristol Bay (Jemison *et al.* 2001). The harbor seal decline was not an isolated event as Steller sea lions (*Eumetopias jubatus*), northern fur seals (*Callorhinus ursinus*), and several species of piscivorous seabirds have also declined in the Gulf of Alaska and the Bering Sea during this same time period (Braham *et al.* 1980, Fowler 1982, Merrick *et al.* 1987, York and Kozloff 1987, Loughlin *et al.* 1992, Springer 1993). Harbor seal numbers in southern and central Southeast Alaska (SE) have remained stable or increased during the past 15 years (Small *et al.* 2001), but evidence of a decline in Glacier Bay National Park (northern SE) has recently been documented (Mathews and Pendleton 2000).

A change in prey abundance and/or availability is one of the leading hypotheses for the cause of the decline in marine mammals and seabirds in the Gulf of Alaska and the Bering Sea (e.g., Merrick *et al.* 1987, Trites 1992, Springer 1993, Merrick *et al.* 1997, Calkins *et al.* 1998, Pitcher *et al.* 1998). Harbor seals eat a wide variety of fish and invertebrate prey, their diet varying seasonally, regionally, and probably annually (Imler and Sarber 1947, Fisher 1952, Wilke 1957, Pitcher and Calkins 1979, Pitcher 1980a), but data on these variations are largely incomplete (Hoover-Miller 1994). The most recent and comprehensive food habits study in Alaska was conducted from 1973 through 1978 in the central and western Gulf of Alaska where 548 seals were collected, 269 of which had food remains in the stomach (Pitcher 1980a). Few historical diet data are available from the Bering Sea and Aleutian Islands regions, and limited information is available from SE.

During the 1990s, the Alaska Department of Fish and Game (ADF&G) began investigating the diet of harbor seals through collections of feces (scat), stomachs, and blubber (for fatty acid signature analyses). Scats were opportunistically collected from haulouts until 1997 when standardized collections began. A biological sampling (biosampling) program began in October 1995 through which a suite of measurements and biological samples (including stomachs and blubber) were collected from harbor seals taken by Alaska Native subsistence hunters. The biosampling program has been a cooperative effort between subsistence hunters, the Alaska Native Harbor Seal Commission (ANHSC), the National Marine Fisheries Service (NMFS), the ADF&G Subsistence and Wildlife Conservation divisions, and the University of Alaska Museum. Since 1994, the diet of harbor seals in PWS has been evaluated through fatty acid analyses of seal blubber (Iverson *et al.* 1997).

Our goals are to establish baseline information on the diet of harbor seals in different regions of Alaska, to monitor changes in diet at certain index sites, and, where possible, to compare current diet with historical data. This report describes the date and location of samples collected, summarizes the number of scats and stomachs that have been processed (cleaned and diagnostic parts identified), presents preliminary results on frequency of occurrence of primary prey items, and describes efforts to enhance ongoing diet studies using fatty acid signature analysis.

## METHODS

### *Scat collections*

We opportunistically collected scats in conjunction with other harbor seal and sea lion field studies in SE, the Kodiak Archipelago, and northern Bristol Bay from 1990 through 1996. In 1997, standardized collections were initiated in these same regions during three seasonal collection periods: winter (November through March), spring (April through mid May), and late summer/autumn (August through October). We opportunistically collected scats during the pupping and weaning periods (mid May through July) during capture operations or when seals abandoned their haulout. We attempted to collect 75 scats seasonally from each region in order to have adequate statistical power to detect seasonal, annual, and regional differences.

Individual scats were placed in Ziploc bags, labeled, and frozen as soon as possible. Frozen scats were sent to the University of British Columbia where they were put through an elutriation process that separated the skeletal parts from the rest of the feces. Skeletal remains were identified by Pacific Identifications in Victoria, British Columbia.

### *Stomach collections*

We obtained harbor seal stomachs from Alaska Native subsistence hunters. Most stomachs were collected in PWS and SE, although a small number of stomachs were obtained from other regions of the state. We used stomachs collected during winter months (November – March), when most hunting occurs (Wolfe and Hutchinson-Scarborough 1999), to compare annual differences in winter diet. Stomachs were frozen as soon as possible after collection, and then shipped to Juneau where they were thawed and the contents rinsed through a series of progressively smaller sieves, retaining all hard parts. The prey remains were thoroughly dried and then shipped to Pacific Identifications for identification.

### *Fatty acids*

Following the methods of Iverson *et al.* (1997), we collected blubber samples through the biosampling program and during capture operations to evaluate diet through fatty acid signature analysis. We obtained harbor seal prey samples from fisheries biologists in SE and Kodiak; these samples will be used to determine the extent of regional differences in fatty acid signatures within a prey species. Blubber and prey samples were sent to Sara Iverson at Dalhousie University, Nova Scotia, for analysis. The fatty acid work compliments and enhances the work that has been conducted in PWS.

## RESULTS AND DISCUSSION

A total of 1,345 scats were collected from 1990 – 1999 in SE, along the Kodiak Archipelago, and in the Bering Sea (Table 1); of these, 1,304 had identifiable prey remains. The most frequently occurring prey identified in 558 scats from SE were walleye pollock (*Theragra*; 50%) and arrowtooth flounder (*Atheresthes*; 33%) (Table 2). Top ranking prey identified from 321 scats from the Kodiak Archipelago were Irish lord (*Hemilepidotus*; 43%) and sandlance (*Ammodytes*; 25%). In the Bering Sea, 425 scats were analyzed with sandlance (45%), rock sole (*Lepidopsetta*; 44%), flounders (Pleuronectidae; 33%), sculpin (Cottidae; 33%), yellowfin sole (*Limanda*; 28%), rainbow smelts (*Osmerus*; 26%), and tomcod (*Microgadus*; 24%) ranking as top prey. Preliminary results suggest regional differences in diet diversity. In the Bering Sea and along the Kodiak Archipelago, there were 11 and 13 prey groups, respectively, that occurred in at least 10% of the scats. In SE, only five prey groups occurred in at least 10% of the scats (Table 2).

From 1995 – 1999, 301 stomachs were collected and processed. Ninety-two percent (278) of the stomachs were collected in SE and PWS; of these stomachs, 72% (199) contained prey items and the rest were empty (Table 3). Based on percent occurrence, top ranking prey items were similar in SE and PWS, including herring (*Clupeidae*), cephalopods, and pollock (Table 4). In SE, six prey groups were present in at least 10% of the stomachs whereas four prey groups were present in PWS. Diet data obtained from stomachs and scats in SE are not directly comparable as scats were collected from inside waters whereas stomachs were primarily obtained from the outer coast. Biases occur with both methods of studying diet; for example, some prey, such as cephalopods, may be overrepresented in stomachs but underrepresented in scats (Pitcher 1980b).

Blubber samples were collected from 41 pups tagged on Tugidak Island and from 24 seals harvested by subsistence hunters in SE. Previous analyses of blubber samples collected from seals along the Kodiak Archipelago, Yakutat, and SE show different fatty acid patterns, suggesting differences in diet among these regions (Iverson *et al.* 1997). At present, little information is available on the variability of fatty acids within a prey species across regions. One hundred twenty-seven herring samples from six regions of SE were collected and shipped to Sara Iverson. Additional prey samples have been collected from SE and Kodiak; these samples are being prepared (sorted and measured) and will be shipped for analysis. Efforts will continue to collect prey samples from SE and along the Kodiak Archipelago.

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Table 1. Year, region, month, sample size, and location of harbor seal scat collected between August 1990 and October 1999.

Year	Region	Months	N	Location
1990	Bering Sea	Aug - Oct	39	Nanvak Bay
1991	Bering Sea	Apr - Jul	35	Nanvak Bay
1991	Bering Sea	Aug - Oct	40	Nanvak Bay
1992	Bering Sea	Apr - Jul	48	Nanvak Bay
1992	Bering Sea	Aug - Oct	81	Nanvak Bay
1997	Bering Sea	Aug - Oct	52	Nanvak Bay
1998	Bering Sea	Aug - Oct	59	Nanvak Bay
1999	Bering Sea	Aug - Oct	75	Nanvak Bay
<b>TOTAL</b>	<b>Bering Sea</b>		<b>429</b>	
1995	Kodiak	Aug - Oct	28	Eastern Kodiak Archipelago
1995/1996	Kodiak	Nov - Mar	3	Western Kodiak Archipelago
1997	Kodiak	Aug - Oct	45	Eastern & southern Kodiak Archipelago
1997/1998	Kodiak	Nov - Mar	21	Eastern & southern Kodiak Archipelago
1998	Kodiak	Aug - Oct	74	Southern Kodiak Archipelago
1998/1999	Kodiak	Nov - Mar	53	Eastern & southern Kodiak Archipelago
1999	Kodiak	Apr - Jun	12	Southern Kodiak Archipelago
1999	Kodiak	Aug - Oct	85	Eastern & southern Kodiak Archipelago
<b>TOTAL</b>	<b>Kodiak</b>		<b>321</b>	
1995	Southeast	Apr - Jul	7	Stephens Passage / Frederick Sound
1995	Southeast	Aug - Oct	71	Stephens Passage / Frederick Sound
1995/1996	Southeast	Nov - Mar	94	Stephens Passage / Frederick Sound
1996	Southeast	Apr - Jul	4	Stephens Passage / Frederick Sound
1997	Southeast	Aug - Oct	69	Stephens Passage / Frederick Sound
1997/1998	Southeast	Nov - Mar	65	Stephens Passage / Frederick Sound
1998	Southeast	Apr - May	42	Stephens Passage / Frederick Sound
1998	Southeast	Aug - Oct	77	Stephens Passage / Chatham Strait
1998/1999	Southeast	Nov - Mar	69	Stephens Passage / Tenakee Inlet
1999	Southeast	Apr - May	12	Stephens Passage / Icy Strait
1999	Southeast	Aug - Oct	85	Stephens Passage / Frederick Sound
<b>TOTAL</b>	<b>Southeast</b>		<b>595</b>	

Table 2. Percent occurrence of prey identified from harbor seal scats collected in Southeast Alaska (n = 558), along the Kodiak Archipelago (n = 321), and the Bering Sea (n = 425) from 1990 through 1999. Prey items that occurred in <10% of scats are not included in table.

		Southeast	Kodiak	Bering Sea
Order	Pleuronectiformes			
	<b>righteye flounders</b>			
Family	Pleuronectidae		13	33
Genus	<i>Atheresthes</i>	33	15	
Genus	<i>Lepidopsetta</i>		13	44
Genus	<i>Limanda</i>			28
Order	Gadiformes			
	<b>codfishes</b>			
Family	Gadidae	13	10	
Genus	<i>Theragra</i>	50	17	10
Genus	<i>Microgadus</i>			24
Genus	<i>Gadus</i>		12	
Genus	<i>Merluccius</i>	15		
Order	Perciformes			
	<b>sculpin</b>			
Family	Cottidae		17	33
Genus	<i>Hemilepidotus</i>		43	
	<b>greenlings</b>			
Family	Hexagrammidae		17	
Genus	<i>Hexagrammos</i>		16	
Genus	<i>Pleurogrammus</i>			17
	<b>sand lances</b>			
Family	Ammodytidae			
Genus	<i>Ammodytes</i>		25	45
Order	Clupeiformes			
	<b>herring</b>			
Family	Clupeidae			
Genus	<i>Clupea</i>	17		11
Order	Salmoniformes			
	<b>salmon</b>			
Family	Salmonidae			
Genus	<i>Oncorhynchus</i>		14	12
	<b>smelts</b>			
Family	Osmeridae			
Genus	<i>Osmerus</i>			26
	<b>squid/octopus</b>			
Class	Cephalopoda		17	



Table 3. Number of harbor seal stomachs collected by subsistence hunters during winter months (November – March) from 1995 through 1999.

	Southeast Alaska	Prince William Sound	Kodiak	Aleutian Islands	Bristol <sup>a</sup> Bay	Total all regions
Total no. collected & processed	157	121	6	4	13 <sup>b</sup>	301
Stomachs containing prey	113	86	5	2	9	215
Stomachs empty	44	35	1	2	4	86

<sup>a</sup> Seals harvested during April – November

<sup>b</sup> Includes 4 stomachs from either harbor or spotted seal

Table 4. Percent occurrence of prey identified from harbor seal stomachs collected in Southeast Alaska (n = 109) and in Prince William Sound (n = 79) from November-March, 1995 through 1999. Prey items that occurred in <10% of stomachs are not included in table.

		Southeast	Prince William Sound
Order	Gadiformes		
	<b>codfishes</b>		
Family	Gadidae	10	
Genus	<i>Theragra</i>	23	27
Order	Perciformes		
	<b>scorpionfishes</b>		
Family	Scorpaenidae		
Genus	<i>Sebastes</i>	24	
	<b>greenlings</b>		
Family	Hexagrammidae	10	10
Order	Clupeiformes		
	<b>herring</b>		
Family	Clupeidae		
Genus	<i>Clupea</i>	39	52
	<b>squid/octopus</b>		
Class	Cephalopoda	28	39